

Memory Distortion in Eyewitness Pairs Who Observed Nonconforming Events and Discussed Them

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A new experimental technique has been invented in which two different events can be presented independently to a pair of subjects sitting side-by-side in front of the same screen so as to make them believe that they are watching the same event simultaneously. Two video projectors with polarizing filters diagonal to each other projected different moving pictures on the same screen. These were observed by a pair of subjects wearing polarizing sunglasses suitable for one or the other video projector. Using this experimental technique, thirty pairs of undergraduates observed basically the same event, but three nonconforming points were included. Each pair of subjects was asked to report individually on what they had seen: Pre-discussion Report. Then they were allowed to discuss the event they had just observed, and were asked to report again: Post-discussion Report. Subjects were invited to come to the laboratory a week later to report what they had seen the week before: Week-later Report. Fifteen pairs of the subjects were instructed to come to agreement during the discussion whereas the other fifteen pairs were simply instructed to discuss what they had seen. In the Week-later Report, subjects in the former group tended to change their memory of the event, either consciously or subconsciously, whereas this tendency was much less in the latter group. In general, the Post-discussion Reports were more complete than the Pre-discussion Reports, that is, the discussion improved the subjects' memory of the events.

Keywords: memory distortion, eyewitness testimony, discussion, nonconforming events, polarization filters

1. Introduction

Suppose an accident happened and was observed by eyewitnesses. The witnesses would probably talk to each other about the accident, or discuss it among themselves. What effects would the discussion have on their witnessed memory?

1.1 Compensation of information through discussion

Takatori (1980) asked participants to memorize rhymes in two different situations: memorizing individually and memorizing in pairs by discussing together. Takatori found that pair-memorizing was superior to individual memorizing. He attributed the high performance of pair-memorizing participants to the fact that discussion would make difficulties in memorizing rhymes explicit, and it in turn could help them to use suitable strategies to overcome these difficulties.

Kanematsu (1992) conducted an experiment in which participants in pairs observed a simulated criminal incident presented by means of colored slides. There were two different conditions compared in the experiment; in the Task-Sharing Condition, participants had been instructed before observing an event to share their tasks of either watching things in the scene or persons as they appeared, while in the Discussion Condition, participants observed an event without any task sharing and after that discussed what they had observed. The performances of participants in the Discussion Condition were not as high as those in the Task-Sharing Condition before the discussion. However, once they had discussed what they had observed, their performances caught up with those of participants in the Task-Sharing Condition. The results were interpreted to mean that observing an event while focusing on a certain aspect would yield better performances than observing without any intentions, but discussion between those who were observing without any intentions could make up for the disadvantages.

1.2 Distortion of memory through discussion

It would be desirable if discussion would only compensate for missing information, but what

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happens if there is any discrepancy or conflict in what witnesses remembered? Loftus (1979) pioneered the research in eyewitnesses' memory distortion. She presented photo slides of a traffic accident involving a pedestrian to participants who acted as eyewitnesses, and asked what they observed just after the slide presentation. The accident was basically as follows: A red car turning right at an intersection hit a pedestrian crossing the road and a green car passed through the location without stopping. After viewing a series of slides, half of the participants were asked several questions in which the experimenter intentionally inserted misleading information such as "Was the car that passed through a blue one?" The other half of the participants were given some neutral questions.

Participants were tested later on whether they could correctly remember the color of the car. The participants given misleading color information tended to answer "blue" or "bluish-green" whereas those given neutral information tended to choose the correct color. The experiment revealed that if wrong information was given even in a question form, witnesses may change their memory. The same result, that witnesses' memory was distorted by questions given after the event, has been confirmed by many studies thereafter. The same result was also observed in child participants (cf., Kikuno, 1993).

1.3 Correction of conflicting information through discussion

Even when people have witnessed the same event, they may remember different information owing to misperception and/or misunderstanding. Though these discrepancies among observers scarcely cause severe problems in daily life, it would be crucially important if discrepancies were found among witnesses of a criminal event or an accident. Therefore, it is an interesting research topic to examine how discrepancies among witnesses can be amended.

However, it is rather difficult to investigate misperceptions or misunderstandings, because they frequently occur in daily life but not consistently in the laboratory setting. This is an intrinsic methodological difficulty in human error research (see, Reason, 1990).

Kanematsu (1992) invented a new presentation technique consisting of two slide projectors with a polarizing filter set perpendicular to each other, both projecting onto the same screen and two pairs of polarizing sunglasses suitable only for one of the overlaid images projected by the two projectors. Using this technique, the researchers can create discrepancies between pairs of viewers by presenting different images secretly and simultaneously to them. In other words, the researchers can create "virtual misperceptions" instead of waiting for them to occur.

The present study developed further the Kanematsu (1992) technique so that video movies were presented rather than still images in slides. It should be noted that two participants watching different movies would naturally think that they were watching the same movie together because they were sitting side by side in front of the same screen.

1.4 Purpose of the present study

The purpose of the present study was to investigate the following two questions: first, how two witnesses who think that they are watching the same event but in reality are being presented different information reconcile the discrepancies through discussion and how their memory of the event is affected and changed during the process; and second, whether discussion between witnesses make their memory performance better.

2. Method

2.1 Presentation technique for two different movies

Liquid crystal displays (LCD) are composed of a pair of polarizing filters with a liquid crystal panel between them which consists of a matrix of liquid crystal cells that can twist polarization direction when electrically charged. Video projectors emit a strong light beam through small LCD panels inside that create images electrically so as to project these images onto a screen outside. Therefore, the light beam emitted from video projectors is polarized in a certain direction.

A pair of video projectors (JVC PD-7) were set perpendicular to each other, one of them being placed sideways, so that the images projected by these projectors were polarized perpendicular to each other. The images projected sideways had been taken sideways beforehand so as to appear upright on the screen at the time of projection. An ordinary video image was in a rectangular frame, wider than its height. A sideways video image was framed horizontally longer.

Therefore, a square window was placed in front of a screen to cut out residuals of these two flames. A half-transparent screen was used and images were projected from the rear so that the two video projectors and other projection apparatus were hidden from the viewers (see Figure 1).

Two pairs of polarizing sunglasses, each one suitable for watching only one of the video images and filtering out the other, were prepared and handed to participant pairs. Despite the difference in polarizing function the sunglasses looked identical to each other.

2.2 Video movie contents

A simulated criminal event in which a male driver and a female partner robbed a female pedestrian while asking directions was performed and videotaped. The total length of the event was about one minute.

Two slightly different versions of the same event were prepared. The following three parts were the only differences between the two versions:

- (1) Color of the car, dark navy color vs. white
- (2) Clothes of the driver, a parka with stripes vs. a white shirt
- (3) Direction of the pedestrian after the robbery, walking up toward the screen vs. walking down away from the screen.

Preparation of criteria for correct recall.

Preceding the experiment, 20 undergraduates who were different from the witness participants had described the event after having watched the video repeatedly and 46 items had been described in this preliminary session. Therefore, these 46 items were used as the base keys for the free recall, and the most frequently described 25 items were used in the cued recall.

2.3 Participants

Sixty undergraduates, 9 males and 51 females, all undergraduate students at Shinshu University voluntarily participated in pairs. Neither interpersonal relations nor gender differences of participants were controlled.

Fifteen pairs were assigned randomly to either of the following two conditions:

Agreement Condition. Participants were to make a unified report together after discussing what they had observed.

Control Condition. Participants were to make an individual report after the discussion.

2.4 Procedure

2.4.1 Instructions

After having entered and been seated in front of the screen, participants were instructed to wear sunglasses to watch a videotaped event that happened in the dark. The instruction saying "an event that happened in the dark" was an excuse for having them wear sunglasses to watch a dark screen.

They were also instructed to watch the screen without tilting their head as much as possible. This instruction was given for reducing the possibility of participants' detection of the duality of the movie.

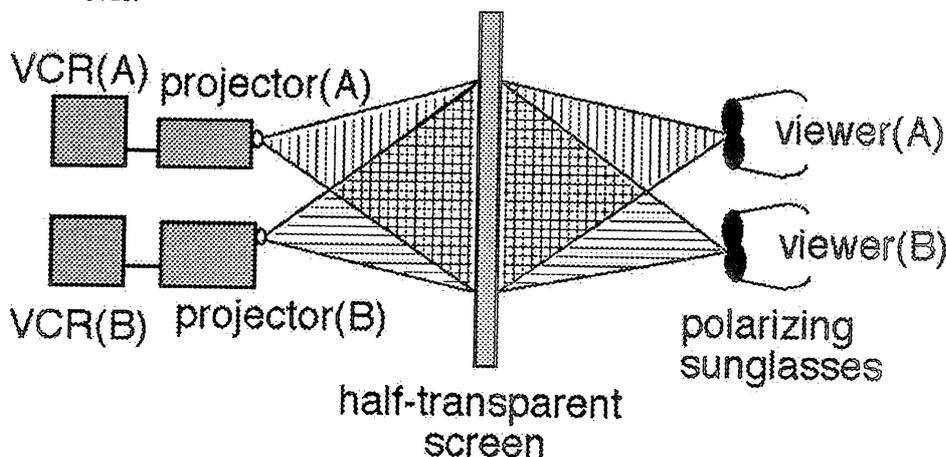


Figure 1. Diagram of the Presentation Apparatus
(Projector B is placed sideways to convert its polarized image perpendicular to the image of Projector A.)

2.4.2 Presentation of the video movie

The presentation was begun after turning off the ceiling lights.

2.4.3 Pre-discussion Reports

After watching the event, participants were given a free recall sheet and instructed as follows: "Please report about what you have just observed on the movie as precisely as possible, what happened where, the clothes of the persons, any special characteristics, etc. Do not talk to or discuss this with each other." The free recall sheets were collected and a cued recall sheet was given individually. The instruction was as follows: "Please answer these questions about the event you have just observed. Again, please do not discuss it with each other."

2.4.4 Discussion

After completion of the Pre-discussion Reports, participants were asked to talk together for five minutes. During the discussion period, they were allowed to look at their reports but not to change what they had written. At the end of the discussion period, Pre-discussion Reports were collected.

2.4.5 Post-discussion Reports

Participants were instructed to make a unified report together (Agreement Condition), or individually again (Control Condition) on what they had observed on a new free recall sheet and a new cued recall sheet, both identical to those of the Pre-discussion Reports. It took about five minutes to complete each of the reports.

2.4.6 Week-later Reports

Participants were invited to come again a week later to report what they had observed one week before. They were instructed to report regardless of the former reports, but to draw an underline in red if they had adopted the answers of the co-witnesses. Again, they filled in two types of recall sheets. It took about ten minutes each. As for the Agreement Condition group, it took them an additional five minutes for integrating their answers.

2.4.7 Introspective Reports

Following the completion of the Week-later reports, participants were asked whether they had noticed the presentation trick or not.

3. Results

3.1 Did participants notice the presentation trick?

Asked whether they had noticed the presentation trick or not, no participants answered that they had noticed it. As a preliminary experiment had shown the same results, the presentation technique was proved to be perfectly effective for presenting two different movies to two groups of viewers simultaneously without them noticing any duality.

3.2 Analyses of Free Recall

Correct answers in free recall reports were converted into percentage scores using the 46 items as the maximum items to be recalled as stated above (See Table 1). As Table 1 shows, Free Recall Scores increased from Pre-discussion to Post-discussion, and further increased a week later (Week-later Reports). Participants in the Agreement Condition group performed better than those in the Control Condition group in Free Recall. An analysis of variances (ANOVA) revealed that those main effects were statistically significant (Recall Periods, $F_{(2,112)}=34.32$, $p<.01$; Experimental conditions, $F_{(1,56)}=11.93$, $p<.01$). An interaction between these main effects was also significant ($F_{(2,112)}=3.87$, $p<.05$). Multiple comparisons using LSD methods revealed that Recall Scores were significantly different before and after the discussion for both experimental conditions ($MSe=47.83$, $p<.05$). The reason why the interaction was significant was mainly due to the fact that the increase after discussion was much larger in Agreement Condition than in Control Condition. The results proved the effect of making unified reports on the memory performances.

3.3 Analyses of Cued Recall

The numbers of correct answers in Cued Recall Reports were converted into percentage scores, Cued Recall Scores (Table 2). The analyses for Cued Recall Scores showed similar results to those of Free Recall Scores; recall scores rose after discussion, and performances in the Agreement Condition group were higher in general. An ANOVA performed on scores in Table 2 revealed that the main effects of both recall periods and experimental conditions were significant

Table 1 Free Recall Scores for the three recall periods

Experimental Conditions	Video Versions	Pre-discussion		Post-discussion		Week-later	
		Mean	SD	Mean	SD	Mean	SD
Agreement	A	48.13	9.63	58.20	9.65	59.47	6.91
	B	45.13	9.03	58.20	9.65	58.80	9.49
	Combined	46.63		58.20		59.13	
Control	A	48.93	8.52	51.60	7.31	53.00	8.87
	B	39.60	10.54	47.40	6.22	48.93	9.11
	Combined	44.27		49.50		50.97	

Table 2 Cued Recall Scores from the three recall periods

Experimental Conditions	Video Versions	Pre-discussion		Post-discussion		Week-later	
		Mean	SD	Mean	SD	Mean	SD
Agreement	A	53.07	7.79	57.60	9.33	57.60	8.98
	B	49.07	10.78	57.60	9.33	57.87	7.98
	Combined	51.07		57.60		57.73	
Control	A	48.00	9.46	52.27	6.28	49.60	9.67
	B	47.47	12.55	53.87	6.67	52.27	7.22
	Combined	47.73		53.07		50.93	

(Recall Periods, $F(2,112)=19.38$, $p<.01$; Experimental Conditions, $F(1,56)=5.43$, $p<.05$). No interactions were significant. Multiple comparisons by LSD method showed that scores in Pre-discussion were lower than those in the other recall periods ($MSE=31.24$, $p<.05$).

The analyses of Cued Recall Scores proved the effects of discussion, as also proved by analysis of the Free Recall Scores. However, the interaction between recall periods and experimental conditions was not significant in the analysis of Cued Recall Scores, and the effect of making an integrated report was not fully confirmed statistically. Nevertheless, increases in Recall Scores after discussion were larger in the Agreement Condition than in the Control Condition, and this tendency was basically same as that of Free Recall Scores.

3.4 Analyses of conformance

The number of conformances between participant pairs was counted on the three non-conforming points for both Free and Cued Week-later Reports. The maximum number of points of conformation was six; three items on two types of reports. Table 3 shows the percentages of conformance in the two experimental conditions. (Free Recall Reports and Cued Recall Reports were quite similar to each other, except there were some omissions in answering the target items in Free Recall Reports. Therefore, scores were combined and put into analyses.) As Table 3 shows, participants in Agreement Condition conformed in nearly 80 percent of the cases, while conformances were almost half in the Control Condition. The difference reached a statistical significance ($t(28)=2.92$, $p<.01$). Therefore, it could be said that participants in Agreement Condition conformed to their partners more often. It would mean that participant pairs would conform more easily when they were obliged to make unified reports together.

3.5 Meta-cognition of the conformance

Participants in the Agreement Condition were to answer what they had seen in the Week-later Report individually. Therefore, those who conformed in the unified reports were able

Table 3 Percentage of conformance in Week-later Reports

Experimental Conditions	Mean	SD
Control Condition	42.2%	38.0
Agreement Condition	76.7	22.7

Table 4 Meta-Cognition of Conforming Answers

Experimental Conditions	Gave Partner's Opinions		Total	Gave Own Opinions Meta-cognition Errors
	With Meta-cognition	Without Meta-cognition		
Control Condition				
Free Recall	24	11	35	5
Cued Recall	22	14	36	3
Agreement Condition				
Free Recall	15	3	18	3
Cued Recall	15	5	20	3

to choose between two answers, either reporting their original observations or reporting the conformed answers. If they chose to agree rather than maintain their original observations, these were voluntary agreements, or voluntary conformities, which were different from the compulsory agreements in the unified reports. The participants were instructed to draw an underline in red if they choose the co-viewer's answer rather than their original observation as their own answer. In this way, we could distinguish between the two types of conforming answers; with meta-cognition (i.e., participants were aware of the fact that they adopted the co-viewer's answers), or without meta-cognition (i.e., participants unconsciously adopted the co-viewer's answers). Table 4 shows the frequency of occurrences of conforming answers in terms of meta-cognition. The maximum was 45, because there were three conflicting items each for 15 participant pairs. There also found another type of meta-cognition errors; participants answered correctly choosing their own original answers rather than their co-viewer's in spite of the red underling. Those meta-cognition errors are also listed in Table 4.

Table 4 clearly shows that there were more unconscious conforming answers as well as more conforming answers themselves in the Agreement Condition. There were only three to five unconscious conforming answers. Their frequency was almost equal to that of meta-cognition errors in the leftmost column of Table 4. As stated above, unconscious conforming answers were a type of meta-cognition error. These two types of meta-cognition error occurred similarly across two experimental conditions for both recall conditions except meta-cognition as unconscious conforming answers in the Agreement Condition. This would mean that making unified reports would cause meta-cognition errors only to produce unconscious conforming answers but not to produce overall meta-cognition errors.

3.6 Confidence ratings and conformance: which of the pairs conformed?

Participants rated their confidence from "absolutely confident=7" to "least confident=1" for each answer in the Pre-discussion Cued Reports. It is reasonable to expect that witnesses who were less confident would be more likely to conform to their more confident partners when they were asked to make a unified report.

Table 5 shows the confidence ratings of those witnesses in the Agreement Condition on the three conflicting points; those whose answers changed in the Post-discussion Report are circled. It was clear from Table 5 that less confident witnesses tended to defer to more confident ones. There were only two exceptional cases (the third conflicting item in participant pair #6 and the second item in pair #12) out of 45 observations in total. There were two other cases in which more confident respondents appeared to conform to less confident ones. However, in those cases, the more confident ones had answered wrongly before discussion and their responses happened to match with those of less confident partners. Therefore, they were not instances of conforming. It should be noted that there were only four pairs (#2, 3, 7, and 14) in which one conformed to

**Table 5 Confidence Ratings on Pre-discussion Cued Report and Conformity.
(Fifteen pairs in the Agreement Condition)**

Color of the car		Driver's clothes		Pedestrian's direction	
Version A Dark	Version B White	Version A Stripe	Version B White	Version A Front	Version B Back
<u>②</u> a) b) c)	7	③	7	7	⑥
⑤	6	②	6	⑦	7
⑤	7	①	2	⑥	7
④	4	2	1	⑦	7
⑥	7	○ _{d)}	3	7	⑦
⑤	6	①	5	6	⑦
7	⑤	7	②	7	○
③	6	○	5	7	⑦
7	②	⑤	3	7	②
7	④	2	4	⑦	7
⑦	7	6	④	7	⑥
③	7	1	③	⑤	6
7	④	e)		--f)	--○
④	6	○	2	⑥	7
⑤	2	①	1	7	6

a: 7="absolutely confident", 1="least confident."

b: Underline denotes wrong answers.

c: Circled numbers denote those answers which were changed to conform to the co-viewer.

d: Circles alone denote no answers and no confidence ratings.

e: Blanks mean no answers and no confidence ratings.

f: Two dashes (--) show answers with no confidence ratings.

the other on all three items. The four always-conforming ones might have had less assertive personalities, which might have been why they deferred all the time. In the other 11 pairs, conforming answers were not produced unilaterally by only one of the pairs. They might have mutually compromised by deferring to each other in trade. If these interpretations were right, conforming would involve not only confidence but also the personalities of the participants and their social skills for maintaining interpersonal relations. However, frequencies of occurrence of these conforming patterns were almost identical to the chance level. If personality had been a main cause, there should have been more unilateral conforming pairs. On the contrary, if participants had considered their interpersonal relations first, there should have been more balanced patterns. Therefore, it is more probable to conclude that confidence was the most decisive factor in conforming.

3.7 Analyses of confidence ratings after conformance

The preceding analyses revealed that participants, having once deferred to their partners, treated the newly adopted opinions as their own. How about their confidence in their new opinions?

Figure 2 shows 36 observations in which one of the pair conformed to the other on the three target items in the Week-later Report being classified in terms of confidence ratings and their awareness of conforming. For the sake of comparison, the confidence ratings of the partners are also listed in the left panel.

Figure 2 demonstrates several interesting points. (1) First of all, those who conformed had weaker confidence ratings than their counterparts in general. (2) Even so, the confidence level of those who conformed was quite high. In 22 out of 36 cases, they marked 5 (i.e., "rather confident") or higher on their answers that were newly adopted after discussion with their partners and were therefore different from their original ones. (3) Moreover, even those who provided adopted answers without being aware of it (without meta-cognition) mostly rated their confidence levels at 5 or higher.

Why were they so confident about what they had not observed in fact? A probable answer is that the confidence was inherited from that of the partners. In other words, "I am confident of

confident in their answers if they answered the same questions repeatedly. They hypothesized that social pressure was responsible for maintaining one's own opinions from these results. A similar interpretation can be made for the results of the present study. Those who had conformed to their partners after discussion and reported together their answers to the experimenter must have felt a responsibility not to change their opinions so easily. Therefore, they answered the adopted ones while recognizing that they had been the partner's original opinions rather than their own.

4.3 Relation to real life

Rumelhart and Ortony (1976) claimed that memory was not a stored input itself but the product of an input and an interpretation of it. Fischhoff (1975, 1977) also stated: "It may involve both reinterpreting previously held information to make sense out of it in light of the reported answer and strengthening associative links with reasons supporting the reported answer. These processes are so natural and immediate that people don't appreciate the effect that hearing the answer has had on their perceptions."

In the present experiment, it was revealed that discussion had positive effects on improvement of memory performance by assisting participants in making an overall image of the event. On the contrary, discussion also allowed those who had not observed certain details to create a pseudo-memory. This result gave an important implication to judicial cases in real life. It would mean that eyewitness testimony might not be 100% trustworthy. What happens if eyewitnesses of a criminal event have discussed among themselves and have created their own integrated interpretation of the event before they are questioned formally by police? For example, a witness who has only vaguely observed an accident but overheard other witnesses saying the driver was in the wrong, may testify that the driver was at fault.

It is remarkably important to note the result stated in Section 3.7. It suggests that confidence ratings are not credible indices for measuring correctness of memory. The majority of participants who conformed to their partners and therefore answered differently from what they had actually observed were considerably confident in their "wrong" answers. Moreover, most of them showed confidence even though they were aware of the fact that their answers were adopted ones. Even worst, those who did not notice their adoption answered with high confidence in some cases.

As Hastie et al. (1978) claimed, when witnesses are asked to testify repeatedly, they may state with confidence what they had adopted from other witnesses as their own having forgotten the correct source of their memory because they were subject to social pressure such as "People should be confident of their own opinions." The present experiment has clearly shown this.

4.4 Discussion alone would not distort memory

It should be mentioned finally that participants did not change their answers even after they had learned that their answers were different from those of the partners who had observed the same event together. Participants in the Control Condition conformed in only 42% of the disputed cases. On more than half of the occasions, their original answers were maintained. This may be partly because the differences secretly inserted in the presented video event were too large to reconcile easily. Nevertheless, it was found that the majority of participants would not change their opinions by discussion alone. Hence, it should be concluded that making and issuing "formal unified reports" had a crucial role in distortion of witnesses' memory.

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